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Short Communication

An Evolution in Medical Physics and Radiotherapy Practice

Seyed Alireza Mousavi Shirazi*

Nuclear Energy Engineering, Assistant Professor and Full Time Faculty Member in Department of Physics, South Tehran Branch, Islamic Azad University, Tehran, Iran

***Corresponding Author:** Seyed Alireza Mousavi Shirazi, Nuclear Energy Engineering, Assistant Professor and Full Time Faculty Member in Department of Physics, South Tehran Branch, Islamic Azad University, Tehran, Iran.

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Introduction

Despite the advancement of technologies in medical radiation and nuclear to better treat cancerous tumors, I am a pioneer in the creation of a novel method and technology in medical physics and medical radiation both to achieve accurate dosimetry and obtaining the best-required irradiation time in the radiotherapy practice. In this investigation, I carried out much research in the fields of medical physics and medical radiation, and I applied some software and nuclear code, including MATLAB software and the MCNPX code.

Some of the features of this research are as follows:

- Designing a liver phantom taken from real liver tissue for dosimetry purposes.
- Simulation of the phantom and dosimetry of it.
- Accurate dosimetry of real liver tissue for the course of X-ray radiotherapy.
- Comparing the dosimetry results obtained from the liver phantom and the liver tissue to verify the designed phantom.
- Applicability of the phantom for dosimetry of a real liver tissue based on the obtained results.
- Obtaining the required irradiation time for this course.

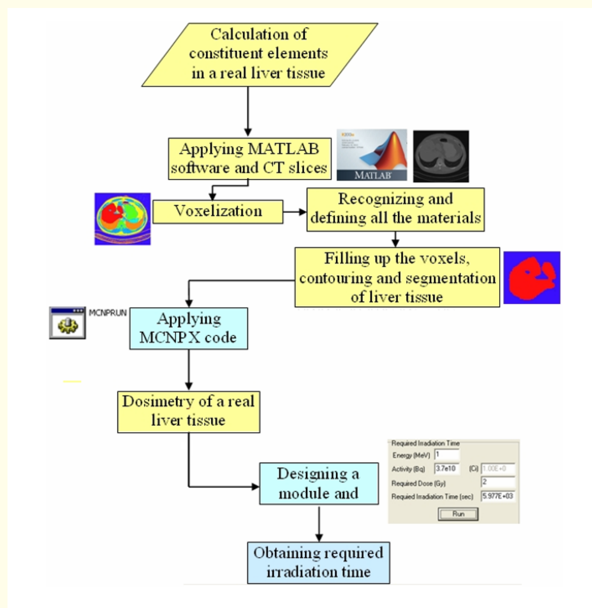

Figure 1: The full block diagram of the research.

Methodology

- Extraction of the materials of any organ in the abdominal tissue.
- Decomposing each of the materials in an adult liver tissue including water and some organic compounds into its constituent elements based on mass percentage and density of every element.
- Making a correlation between the accurate mass of every decomposed material of human liver tissue with masses of the phantom components.

- Simulation and dosimetry of real liver tissue by DICOM images, MATLAB software, and the MCNPX code.
- Application of the Di-Com images of CT scan belonging to a male's abdominal tissue from YZ direction in the Cartesian coordinates in a way that the front view of the liver appears.
- Recognizing the type of each material based on the level of grayness and Hounsfield Unit scale (HU) of DICOM CT slices.
- Making a large number of volumes as voxel and repeating them to build up the full geometry of tissue.
- Assignment of each radiodensity to that voxel.
- Filling up every voxel completely homogeneous with the existing materials in the abdominal tissue.
- Contouring the liver tissue and separating it in the abdominal tissue.
- Transferring the generated data into the MCNPX code.
- Designing a module based on absorbed dose to obtain the required irradiation time.
- Applicability of this method for every patient through his/her own CT scan images to determine the admissible absorbed dose.

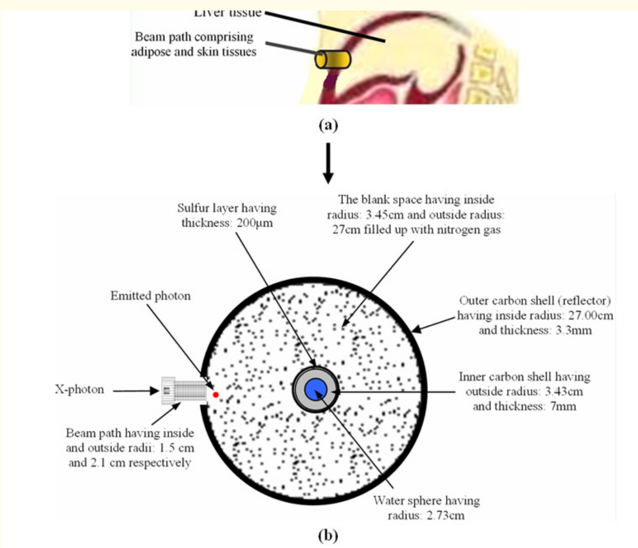

Figure 2: (a) The side view of the cylindrical tube path and liver tissue

(b) The schematic view of the equivalent liver phantom.

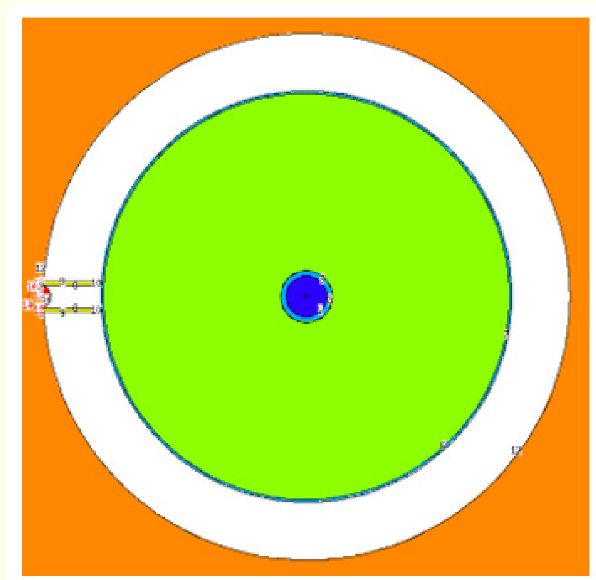

Figure 3: The equivalent liver phantom simulated by the MCNPX code.

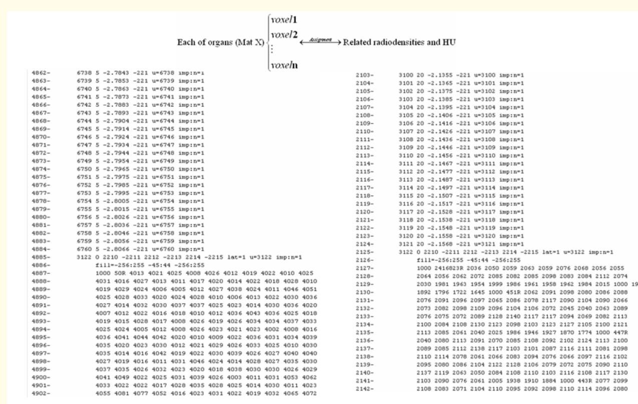

Figure 4: The data generated by MATLAB programming and transferred to MCNPX code.

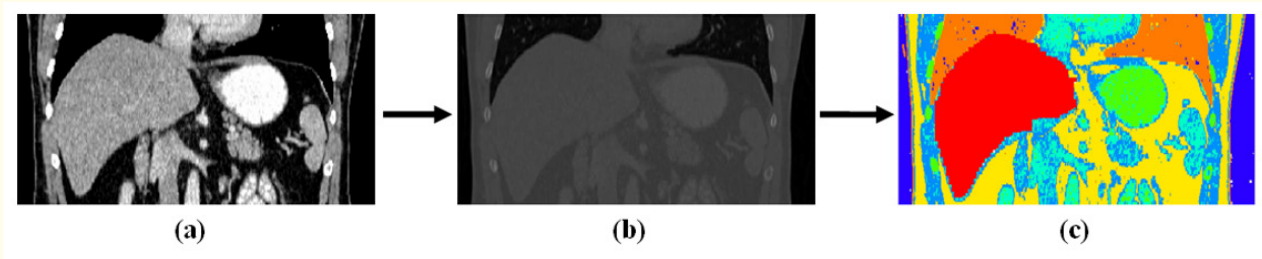

Figure 5: (a) The DICOM image of the abdominal region

(b) The image of the abdominal region converted from DICOM to a new image extracted from MATLAB software

(c) The abdominal region image converted to a new image extracted from the MCNPX code.

Figure 6: The views of the liver phantom, real liver tissue, and the segmented liver tissue.

- Applicability of the designed liver phantom for dosimetry for the sake of studying photon behavior in materials of liver tissue.
- Feasibility of standardizing the obtained results for similar investigations about liver tissue and determining the required irradiation time to reach the desirable dose for each patient.

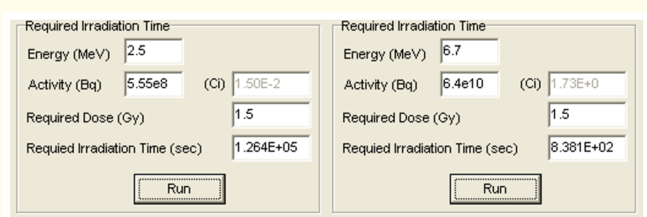

Figure 7: The accurate irradiation time obtained in seconds by the software with respect to the desired treatment dose at different intensities (in Bq) and X-ray photon energies (MeV).

Conclusions

- A fairly good agreement between the amounts of absorbed doses obtained from the prepared liver phantom and the real liver tissue.